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Business Case Analysis of Prototype Fabrication Division Recapitalization Plan—Summary

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Summary

Important experiments related to nuclear weapons often require precision-machined parts of various materials in both classified and unclassified shapes. Because of the integrated nature of these experiments, delays in parts manufacturing can lead to cascading schedule issues for important programmatic milestones. The machining tools currently employed for these programs are relatively old, necessitating time-consuming inspections and potential scrapping of parts. Establishing what equipment and facilities are needed to maintain necessary and optimal capabilities is crucial for the long term success of the weapons experimental mission.

Business case studies were completed to support procurement of new machines and capital equipment in the Prototype Fabrication (PF) Division SM-39 and TA-03-0102 machine shops.[1] Economic analysis was conducted for replacing the Mazak 30Y Mill-Turn Machine in SM-39, the Haas Vertical CNC Mill in Building 102, and the Hardinge Q10/65-SP Lathe in SM-39. Analysis was also conducted for adding a NanoTech Lathe in Building 102 and a new electrical discharge machine (EDM) in SM-39 to augment current capabilities. To determine the value of switching machinery, a baseline scenario was compared with a future scenario where new machinery was purchased and installed. Costs and benefits were defined via interviews with subject matter experts.

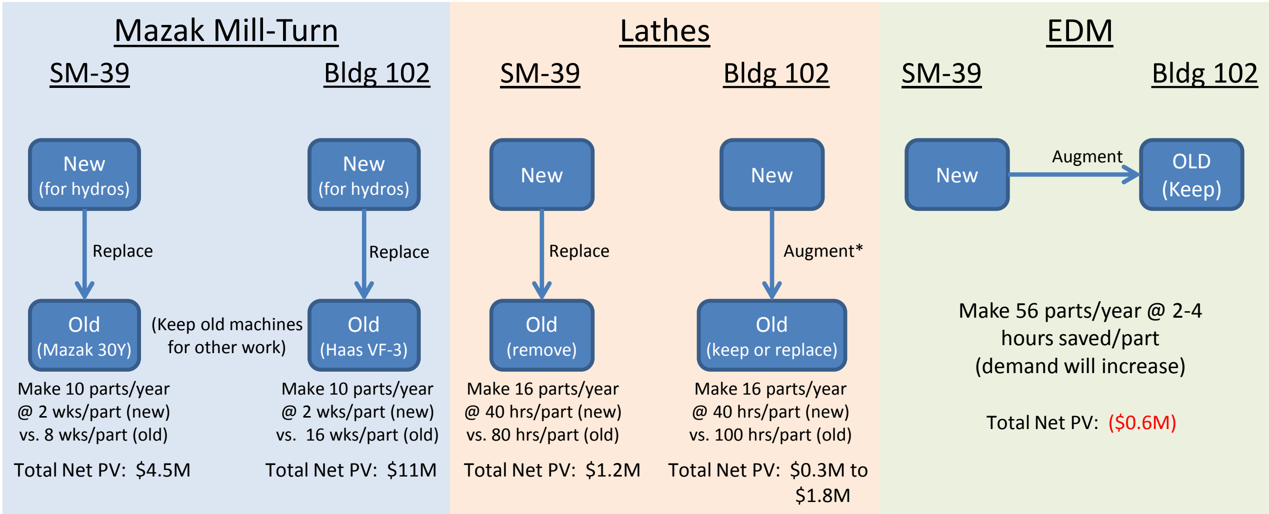
The results of the analysis were compiled in life-cycle cost/benefit tables. Productivity savings were included as a measure to show the costs avoided by being able to produce parts at a quicker and more efficient pace. The best-estimate results from the analysis are summarized in Figure 1.

Mazak Mill-Turn Replacement in SM-39

The Mazak Integrex 30Y in SM-39 was obtained from Sandia National Laboratories in Albuquerque when their machine shop closed. The 30Y is a mill-turn machine that works well for hydrodynamic experiment (hydro) parts. Unfortunately, it is a 1986 vintage machine that cannot hold tolerances well. The requirements-based tolerances for the machine need to fall within a band that is 0.013 mm wide. This accuracy is not consistently being achieved due to the age of the machinery and a number of other factors.

The lack of accuracy with the Integrex 30Y leads to a need for continual "in-process" inspections, which require that a part be removed and reinstalled from the machine multiple times. This is a time-intensive process that dramatically increases production time and can further affect the integrity of the product. In general, machines require far more maintenance as they age and pass their intended useful lives. In

[1] For full report, see: Booth, Steven R.; Benson, Faith A.; Dinehart, Timothy G.; "Business Case Analysis of Prototype Fabrication Division Recapitalization Plan," LA-UR-15-????, April 2015, forthcoming.



*Note: One of the Ex-Cell-O T-base lathes failed the week of March 2, 2015, and the other Ex-Cell-O T-base lathe is expected to fail as well. This scenario may become a replacement.

Figure 1: Comparison of scenarios described in this report shows the relative net present values of each business case analysis.

addition, some of these machines are so old that the original manufacturers no longer provide maintenance services, and in some cases have no drawings or replacement parts.

The estimated total net present value of replacing the Mazak Integrex 30Y in SM-39 with a Mazak Integrex i300 is $4.5M over fifteen years of operation. The total procurement and installation cost is about $940k. The project achieves pay back of its investment in the fifth year after procurement. Assuming maximum production (23 parts per year) of the new machine, the net present value could be as high as $11.4M and would break even in the fourth year. Under the minimum production case (6 parts per year) there would be a net present value of $2.9M and a breakeven point in the sixth year after procurement.

Haas Vertical CNC Mill Replacement in Building-102

The Haas VF-3 Vertical CNC Mill Machine in Bldg-102 is a 2007 vintage model. Precision work on complex geometry with radiological parts is currently done on this machine. This option is less than optimal as shown by recent experiences building inner and outer saddle parts for several hydrodynamic tests. For the 3630 hydro shot (~2010 to 2011), the VF-3 had a hard time keeping the profile within tolerance. Subsequently, the PF maintenance team conducted a “laser-shoot” of the machine to check tolerance and geometries in a precise mapping of performance. The results showed the machine was out of specification in all three axes. A corrective map was added to the controller with the goal of bringing the machine back into specification. However, subsequent shots have shown a continuous failure to meet proper tolerances.

Under the best estimate assumptions of ten parts per year, replacing the old Haas VF-3 with a new Mazak Integrex has a total net present value of $11M over a seventeen-year project life. The total cost of procurement and installation is about $920k. Using the new machine for a minimum of six parts per year leads to a $7M total value, whereas a maximum production of 23 parts per year has a $23.5M value. The project has a pay back in the fourth year under all three production assumptions.

Hardinge Lathe Replacement in SM-39

A NanoTech lathe will be used to replace one of the decade-old Hardinge Q10/65-SP models in SM-39. The Q10/65-SP lathes are used for cutting components for weapons programs and experiments. The current annual demand is about 10 stainless steel parts and sixteen depleted uranium (DU) parts. The demand could ramp up to 40 to 80 parts per year to meet future programmatic needs. The addition of new lathes will accommodate this anticipated increase.

The estimated total net present value of replacing a Hardinge Q10/65 lathe in SM-39 with a NanoTech is $1.2M over fifteen years of lathe operation. The upfront procurement and installation cost is about $1.1M. The project achieves pay back of its investment in the tenth year after procurement with an assumed production of 16 parts. Assuming maximum production of the new machine (46 parts per year), the net present value could be as high as $3.7M and would break even in the seventh year. Under the minimum production case (10 parts per year) there would be a net present value of $0.7M and a breakeven point in the twelfth year after procurement.

NanoTech Lathe Installation or T-base Replacement in Building 102

The business case for the lathes in Building 102 considers adding a NanoTech lathe to augment existing capability. It should be noted that this analysis assumes the two existing Ex-Cell-O T-Base lathes in Building 102 are fully functional. However, during the week of March 2, 2015, PF took down one of the Ex-Cell-O T-base lathes and found damage on one of the spindles indicating the entire spindle housing needs to be replaced. In view of this, an additional analysis was conducted to indicate the total net present value if the existing lathe had to be replaced.

The estimated total net present value of installing a NanoTech in Building 102 to augment existing capability is $0.3M over fifteen years of lathe operation with an assumed production of 16 parts per year. Upfront investment cost is about $1.2M. The project achieves pay back of its investment in the fifteenth year after procurement. Assuming maximum production of the new machine (46 parts per year), the net present value could be as high as $4M and would break even in the seventh year. Under the minimum production case of 10 parts per year there would be a net present value of ($0.4M), with no breakeven point. See Figure 2.

The dashed best-estimate line in Figure 2 shows results for the additional scenario of replacing a T-base lathe in Building 102. This line reflects a modest assumed demand of sixteen parts per year for the new machine. The estimated total net present value is $1.8M over fifteen years of lathe operation. The project achieves pay back of its investment in the ninth year after procurement.

Wire EDM Installation in SM-39

Electrical discharge machining (EDM) is a technology that is useful for cutting intricate contours or cavities/holes in very hard metals that are difficult to machine using traditional milling and turning methods. The EDM cuts via a large number of current discharges or “sparks,” each of which remove small amounts of material from the tool and work piece creating tiny craters on both surfaces. A wire EDM uses a continuously replaced wire fed by a spool to handle this “wear” on the electrode.

The MD8 wire EDM in SM-39 is a small capacity machine that was purchased with operational funds for about $80k. The Agie-Charmilles Cut 300 Wire EDM in Building 102 is fairly new (vintage 2008) and will not be replaced at this time. The proposed new wire EDM for SM-39 will be similar to this machine and will allow non-hazardous parts that are currently handled in Building 102 to be produced at lower

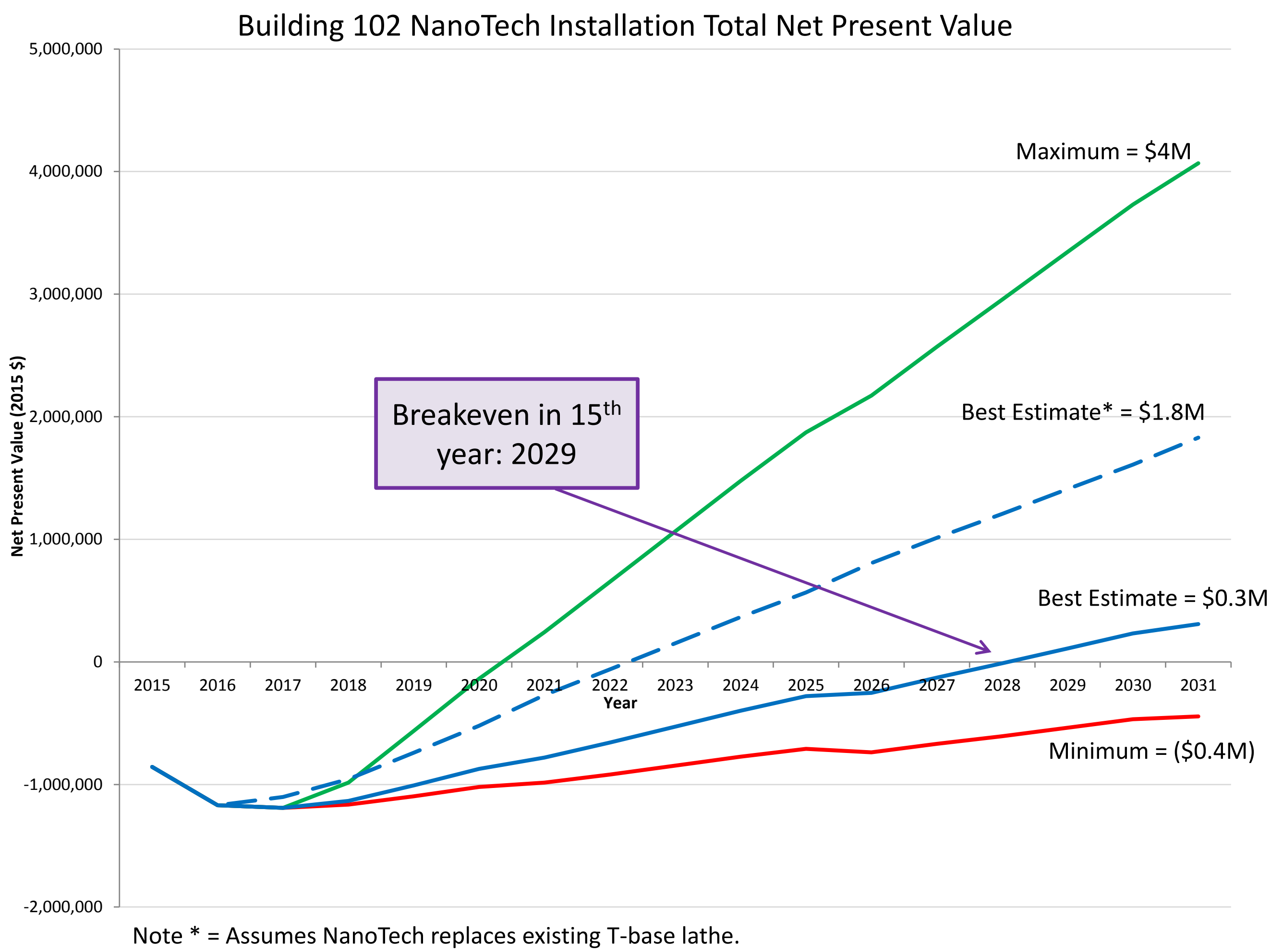


Figure 2: For each equipment analysis, a payback graph such as the one shown above was generated. The payback period for installing a new NanoTech lathe to augment capacity in Building 102 under the best-estimate assumptions is in the fifteenth year, with a $0.3M savings over a 17-year project life. The payback period for installing a new NanoTech lathe to replace an existing lathe in Building 102 under the best estimate assumption is in the ninth year, with a $1.8M savings over a 17-year project life.

expense in SM-39. The new EDM will be used for weapons experiments to cut holes with precise angles and semi-circular “mouse holes” in spherical objects. In addition, the flexibility of the machine will encourage an increased number of production tasks in the future.

The estimated total net present value of installing a new EDM in SM-39 is ($0.6M) over fifteen years of EDM operation. The upfront investment cost is about $700k. The project does not achieve pay back of its investment over the fifteen-year life of the machine. Assuming maximum production of the new machine, the net present value could be as high as $1.1M and would break even in the eighth year. Under the minimum production case there would be a net present value of ($0.9M) with no breakeven point.